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TECHNICAL PROPOSAL

NO. TP-5500-2.7

[redacted] CRYSTAL-VIDEO ANTENNAS

25X1

[redacted]

25X1

Prepared for:

[redacted]

25X1

July 1955

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[redacted]

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INTRODUCTION

This proposal includes the design and packaging of nine antennas and crystal holders to cover the frequency range from 50 megacycles to 40,000 megacycles. This frequency range is broken up into the following bands: Band 1, 50 - 110 Mc; Band 2, 110 - 250 Mc; Band 3, 250 - 500 Mc; Band 4, 500 - 1,000 Mc; Band 5, 1,000 - 2,200 Mc; Band 6, 2,200 - 4,500 Mc; Band 7, 4,500 - 10,000 Mc; Band 8, 10,000 - 20,000 Mc; Band 9, 20,000 - 40,000 Mc.

Four antennas will be required for each band. Each antenna should have between 80 - 105° halfpower beamwidth, low VSWR and axial ratio with design goals of 3:1 or better. The design goal is to achieve at least 45 dbm tangential sensitivity in each band. The discussion to follow is divided into three parts. Part I is a detailed discussion of the antennas proposed for this system. Part II is a detailed discussion of the crystal holders to be used in this system. Part III is a detailed discussion of the over-all packaging of the final system.

PART I - ANTENNAS

As a result of a conference attended by Navy representatives, [redacted], the following program is suggested for obtaining 25X1 a satisfactory system of antennas and crystal holders to cover the bands specified above:

a. Bands 1 and 2 (50 - 250 Mc.)

If one antenna can be used for these two bands, the

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packaging problem will be greatly reduced. Therefore, this proposal considers only one antenna for Bands 1 and 2 and every effort will be made to permit one antenna to cover the full range. This antenna will be vertically polarized.

There are five alternatives at the present time which will be investigated. They are:

1. Resonant dipole in front of absorbing plate or reflecting screen
2. Modified discone in front of absorbing plate or reflecting screen
3. Quarter section discones backed by absorbing plates
4. Resonant bow tie in front of reflecting screen or absorbing plate
5. Spiral antenna

Scale models of the resonant dipole and modified discone types will be furnished by the Navy, [redacted] will fully evaluate 25X1
these models and, if successful, will then build full scale models and test these. If the original scale models fail, the remaining three alternatives will be investigated (at higher frequencies for convenience).

b. <u>Band 3 (250 - 500 Mc)</u>

The conical helix developed by [redacted] may prove satisfactory 25X1
for this band. This helix has the following characteristics as measured in the range 450 - 5,000 Mc. for bandwidths of over 2:1:

1. Very low side lobe levels

2. Circular Polarization with an axial ratio (Power) of 3:1 or less
3. VSWR of 3:1 or less over the band; over most of the band, the VSWR is less than 2:1
4. Halfpower beamwidth averages 60° and is practically constant over entire band
5. Extremely rugged construction due to conical shape
6. No external matching transformers required due to unique construction.

There are two factors, however, which may limit the use of a conical helix for this band:

1. A maximum package diameter of four (4) feet is desirable for Band 2.
2. The conical helices built to date have halfpower beamwidths which vary between 60 and 70°.

Although it looks promising that 90° beamwidths can be achieved, it is not certain that both the 90° beamwidth criterion and the four feet maximum diameter restriction can be met. One suggestion offered by the Navy was that antennas do not necessarily have to be in the same horizontal plane, thus allowing for the possibility of a vertical stack of four helices. This could help the diameter problem if an antenna interaction problem is not created by this move.

In the eventuality that the helix does not prove satisfactory for Band 2, the results of Band 1 development can be resorted to and a linearly polarized, small antenna can be utilized for this

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band, or, a linear slot antenna as suggested by the Navy can be used here.

c. Band 4 (500 - 1,000 Mc)

The conical helix has been approved for this band with the reservation that the 90° beamwidth requirement can be achieved. As an alternative to the helix in the event that its beam cannot be broadened, a linear horn is available for this band. This horn, as indicated by the Navy, can also be of the form of a large waveguide to coaxial adapter with a broadband type probe in the waveguide.

d. Band 5 (1,000 - 2,200 Mc)

Although the Navy has the design of a linear horn for this band, interest was expressed in the conical helix. A comparison will be made between the helix and the horn and a decision as to antenna type will be made at a later date.

e. Bands 6 - 9 (2,200 - 4,500 Mc; 4,500 - 10,000 Mc; 10,000 - 20,000 Mc; 20,000 - 40,000 Mc)

For these four bands, the Navy will furnish drawings from which [redacted] will fabricate finished linearly polarized horns 25X1
for the system. Testing will be required as a check on manufacturing and also as part of the packaging testing to insure system operation.

PART II - CRYSTAL HOLDERS

It is proposed to use crystal holders that will be optimum for each band of frequencies. In some cases, this will require some development and special design. We can anticipate achieving a

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tangential sensitivity greater than 45 dbm over most of the bands of frequencies. Some problems may occur in Band 9.

a. Bands 1, 2, and 3 - it is proposed to do some development on a crystal holder to cover these three bands. It is planned to use a 1N21B crystal in these bands. No serious technical difficulties are anticipated.

b. Bands 4 and 5 - it is proposed to use a UG119/U crystal holder and adapter with a 1N21B crystal for each of these two bands. No development is contemplated and these crystal holders can be built from standard design.

c. Bands 6, 7, 8, and 9 - the crystal holders in these bands are built into the horns per the Navy drawings which will be supplied. Crystal types will be selected which meet the specifications.

d. Conclusions - no difficulties are anticipated in completing the required crystal holders within the time allotted. A small amount of development work is contemplated for Bands 1, 2, and 3, but no technical difficulties are anticipated there. The specifications in connection with tangential sensitivity should be achievable in all bands with the exception of Band 9. Further information will be required before an accurate prediction can be made of tangential sensitivity for Band 9. Crystal shutters will be included in this system.

PART III - PACKAGING

The packaging of this system has some unknowns in it at present due to the fact that some of the antennas cannot be specified until development work has been done. However, the Navy has specified some general considerations which are listed below:

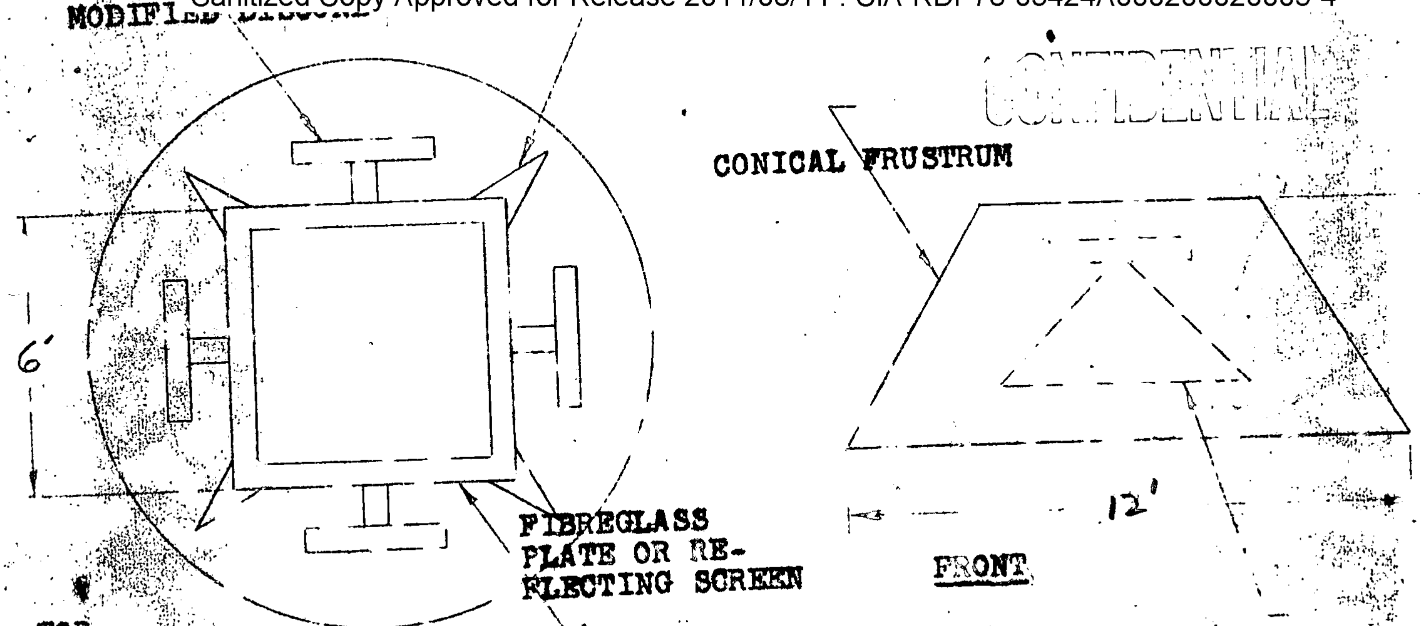
1. Bands 1 - 2 Vertically Polarized; Band 3 Circularly Polarized (Helix), 45° Polarization (Horn), Vertically Polarized (Discone); Bands 4 - 5 Circularly Polarized; Bands 6 - 9 45° Polarization.
2. The system shall meet specification MIL-E-16400 Class 2.
3. The system will be mounted on a mast whose minimum height is 7 feet and whose maximum height is 17 feet.
4. The maximum desirable base diameter should be 12 feet.
5. The preferred system shape is conical with individual sections removable and of a conical frustrum shape. Stacked cylinders were not objected to as an alternative packaging scheme. The basic thought for the package is to keep wind resistance to a minimum.

In view of the above, [redacted] will approach packaging as early 25X1
as possible in the contract because the final package contour is going to require the moulding of fibreglass cones or cylinders. This procedure can be quite time consuming because, since a large production run is not anticipated, the fibreglass pieces will have to be handmade.

Although the following may be changed considerably after the final antennas have been decided upon, it is submitted as a general estimate of what the packaging might look like.

<u>Bands 1 and 2</u>

Assuming that the modified discone works over the entire range, the bottom stack of the package could be as shown in the following sketch:

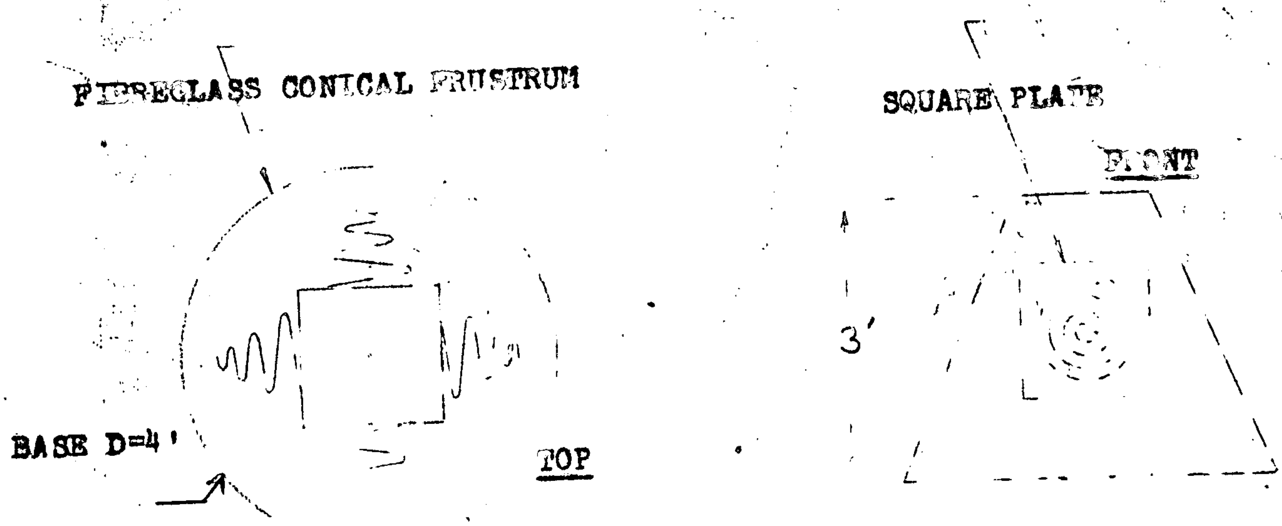


If it turns out that the fabrication of conical fibreglass frustrums is prohibitively expensive, there are two additional lines of approach which can be followed:

1. Fibreglass Cylinders
2. Flat Fibreglass Plates cut such that four of these will form a frustrum of a pyramid.

Band 3

Assuming that the helix is satisfactory, the optimum packaging of Band 3 would look as shown below. This again could be cylindrical or pyramidal instead of a conical frustrum.



Bands 4 - 9

These antennas can either be mounted directly to a solid fibreglass shape, such as a conical frustrum or cylinder, or might have to be mounted to a curved, carbon-filled, honeycomb fibreglass surface. The reasons for using the special carbon-filled plate are:

1. Horn antennas operate far better when they are isolated from other metallic objects. The carbon plates will prevent reflections from some antennas interfering with the operation of others.
2. Since the antennas are all low gain, there may be some back or side radiation present. The carbon plates will absorb this radiation, thus reducing antenna interaction considerably.

The main problem associated with this phase of the packaging, and possibly in the lower bands, is that of fabricating the carbon plate into a curved surface.

One additional method of packaging which will be investigated consists of a large balloon of thin fibreglass cloth held into a spherical shape by a small amount of compressed air. This system has been used successfully by the Signal Corps and, if acceptable and practicable, could simultaneously eliminate the radomes for all antennas and the necessity to camouflage the system.

At this point, the final packaging might take one of four forms:

1. Conical
2. Stacked Cylinders
3. Pyramidal

4. Balloon

If the balloon method is acceptable, the internal construction can be cubical in form which will reduce the complexity of fibreglass forms required.

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PROPOSED BUDGET FOR TP-5500-2.7

[redacted] CRYSTAL-VIDEO ANTENNAS 25X1

22.8 weeks Senior Engineer		$ 3,739.20
16.0 weeks Mechanical Engineer		2,160.00
14.0 weeks Development I Engineer		1,850.00
96.4 weeks Machinist		8,676.00
26.0 weeks Technician		2,184.00
11.0 weeks Drafting		968.00
		$19,577.20
Overhead	95%	18,598.34
Materials		18,414.00
Travel and Communications		210.00
Shipping and Crating		300.00
		$57,099.54
Fixed Fee	7%	3,996.96
	TOTAL	$61,096.50

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